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IEC 674-3-7 (1992)

(Reaffirmed 2004)

भारतीय मानक

विद्युत प्रयोजनों के लिए प्लास्टिक फिल्म

भाग 3 अलग-अलग सामग्रियों की विशिष्टियाँ

अनुभाग 8 विद्युत रोधन में प्रयुक्त फ्लूरोइथाइलीन प्रोपाइलीन (एफ ई पी) फिल्मों की अपेक्षाएँ

Indian Standard

PLASTIC FILMS FOR ELECTRICAL PURPOSES

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

Section 8 Requirements for Fluoroethylene-Propylene (FEP) Films Used for Electrical Insulation

ICS 29.035.20

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

July 1998 **Price Group 3**

Solid Electrical Insulating Materials Sectional Committee, ETD 02

NATIONAL FOREWORD

This Indian Standard which is identical with IEC 674-3-7 (1992) 'Specification for plastic films for electrical purposes — Part 3 : Specifications for individual materials — Sheet 7 : Requirements for fluoroethylene-propylene (FEP) films used for electrical insulation' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Solid Electrical Insulating Materials Sectional Committee (ETD 02) and approval of the Electrotechnical Division Council.

This standard (Part 3/Sec 8) is one of the series of Indian Standards which deals with plastic films for electrical purposes. The series consists of the following parts :

Part 1	Definitions and general requirements
Part 2	Methods of test
Part 3	Individual materials — Specifications

This standard (Part 3/Sec 8) covers the requirements for fluoroethylene-propylene (FEP) films for use as electrical insulation.

In this Indian Standard the following International Standards are referred to. Read in their respective places the following :

International Standard	*Indian Standard*
IEC 674-1 : 1980	11298 (Part 1) : 1985
IEC 674-2 : 1988	11298 (Part 2) : 1987
IEC 757 : 1983 Code for designation of colour	There is no equivalent Indian Standard at present
IEC 674-3-7	11298 (Part 3 / Sec 8) 'For designation of film'

Certain conventions appearing in this dual number standard are not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standard, the current practice is to use a point (.) as the decimal marker.

Only the English language text in the IEC standard has been retained while adopting it in this Indian Standrad.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

PLASTIC FILMS FOR ELECTRICAL PURPOSES

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

Section 8 Requirements for Fluoroethylene-Propylene (FEP) Films Used for Electrical Insulation

1 General

1.1 *Scope*

This International Standard gives the requirements for copolymers of tetrafluoroethylene (TFE) and hexafluoropropylene (HFP), conventionally described as fluoroethylene-propylene (FEP), as films, with or without surface treatments to render the surface cementable and heat sealable.

1.2 *Normative references*

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 674-1: 1980, *Specification for plastic films for electrical purposes - Part 1: Definitions and general requirements.*

IEC 674-2: 1988, *Specification for plastic films for electrical purposes - Part 2: Methods of test.*

IEC 757: 1983, *Code for designation of colour.*

1.3 *Classification*

The FEP film shall be of the following types:

Type 1:	General purpose
Type 2A:	One side treated*
Type 2B:	Two sides treated*

2 Designation

The plastic film shall be identified by the following designation:

Designation of the film - IEC 674-3-7 - FEP - type - thickness in micrometres - width in millimetres - length in metres - colour.

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* Type 2 is surface treated to render the surface(s) heat sealable and cementable.

Example:
Fluoroethylene-propylene - IEC 674-3-7 - FEP - type 1 - 100 - 20 - 200 - nc
(r = regular; nc = natural colour; other colours according to IEC 757).

3 General requirements

The material shall be a flexible, self-supporting film made from FEP copolymer. Type 2 shall be surface treated on one or both sides to give heat sealability and cementability.

All types shall conform to the general requirements laid down in IEC 674-1.

4 Dimensions

4.1 *Thickness*

The film thickness of type 1 shall be measured in accordance with the requirements of 3.3 of IEC 674-2. The thickness of type 2 shall be measured using a micrometer in accordance with 3.1 of IEC 674-2.

The overall thickness shall be in accordance with the nominal thickness and the permitted range of thickness given in table 1.

The following thickness ranges are commonly available:

Type 1: 12,7 to 508 µm;

Type 2: 12,7 to 127 µm.

Table 1 – Nominal thickness and permitted range of thickness (µm)

Type	Nominal thickness µm	Overall permitted range of thickness µm	
		Min.	Max.
1 and 2	12,7	8,9	16,5
1 and 2	25	18	33
1 and 2	51	38	64
1 and 2	76	57	95
1 and 2	127	102	152
1	190	158	223
1	254	216	292
1	356	320	391
1	508	432	584

4.2 *Width*

The film width shall be measured in accordance with the requirements of clause 5 of IEC 674-2.

Preferred widths cannot be given on account of the great variety of applications.

The maximum deviation in film width from the nominal shall be ±1,6 mm.

5 Properties

5.1 *Properties not dependent on thickness*

Table 2 – Property requirements for all types

Property	Requirements	Units	IEC 674-2 Test method Clause
Density	2 150 ± 20	kg/m^3	4, Method D[1]
Melting point	Under consideration		
Permittivity	2,15 max.		16.1[2] 23 °C, 1 MHZ
Dissipation factor	 ≤0,0004 ≤0,0003 ≤0,0006	–	16.1[2] 23 °C, 48 Hz – 62 Hz 23 °C, 1 kHz 23 °C, 1 MHz
Volume resistivity	$\geq 1,10^{16}$ $\geq 1,10^{15}$	Ω · m	15, 23 °C 170 °C
Surface resistivity	$\geq 1,10^{15}$	Ω	14 23 °C, 50 % r.h.

[1] The recommended mixture is 1,3-dibromopropane and ethylene bromide.

[2] Use non-contacting electrodes or evaporated metal electrodes.

5.2 *Properties dependent on thickness*

Table 3 – Property values for all types

Property	Nominal thickness µm	IEC 674-2 Test method Clause	Requirements	Units
Tensile strength, machine direction and transverse direction	12,7 25 - 508	10[1]	≥14 ≥17	MPa
Elongation at break, machine and transverse direction	12,7 25 51 - 508	10[1]	≥175 ≥200 ≥250	%
Dimensional change, shrinkage, machine and transverse direction	12,7 - 25 51 76 - 508	23 (200 °C) 30 min	≤5 ≤3 ≤2	%

[1] Rate of extension 50 mm/min, reference lines 100 mm apart.

Table 4 – Electric strength (a.c. test) for all types

Nominal thicknes µm	Minimum electric strength V/µm	IEC 674-2 Test method Subclause
12,7 25 51	160 160 140	18.1 Using 6 mm diameter electrodes in air
76 127 190 254 356 508	120 100 80 70 65 55	18.1 Using 6 mm diameter electrodes in transformer oil

5.3 *Other properties*

5.3.1 *Thermal endurance*

There is no requirement for thermal endurance because thermal endurance cannot be measured in accordance with the requirements of clause 28 of IEC 764-2 since the low melting point (approximately 260 °C – 280 °C) would require low ageing temperatures and unreasonably long ageing times.

NOTE - Experience indicates that these materials are frequently suitable for service at 200 °C.

5.3.2 *Burning characteristics*

When determined according to clause 29 of IEC 674-2, the classification shall be VTF 0.

6 Roll characteristics for all types

Rolls shall be suitably restrained to prevent unwinding. Material shall be wound evenly and tightly on the roll to prevent uneven edges or telescoping.

6.1 *Roll diameter/film length*

There are no requirements in this standard for roll diameters or film lengths on a roll. These should be subject to contract.

6.2 *Windability/sag*

No requirement.

6.3 *Joins*

Where joins (splices) are permitted, their construction shall conform to the requirements given in 3.3 of IEC 674-1. Breaks (unjoined pieces) shall also be indicated so as to be clearly visible when viewed from the end face of the roll.

The number of joins (splices) or breaks in each roll shall not exceed the values given in table 5.

Table 5 – Maximum permissible number of joins per roll

Nominal thickness µm	Roll nominal outer diameter					
	Core inner diameter 76 mm			Core inner diameter 152 mm		
	<190	190	>190	<241	241	>241
12,7	–	–	–	3	4	7
25	2	3	4	2	3	4
51 – 190	1	2	3	1	2	3
254	–	–	–	1	1	3
356	–	–	–	1	1	1
508	–	–	–	1	1	2

NOTE - The minimum distance between joins or splices or between a join and the end of the roll shall be not less than 30 m for films under 508 µm thickness and 15 m for 508 µm thickness.

6.4 *Roll width*

The maximum difference between the film width measured according to clause 5 of IEC 674-2 and the roll width excluding the core (expressed in millimetres) shall be according to table 6.

Table 6

Core inner diameter ≤77 mm		Core inner diameter >77 mm	
Roll outer diameter ≤241	Roll outer diameter >241	Roll outer diameter ≤280	Roll outer diameter >280
3,2	6,4	3,2	6,4

6.5 *Cores*

The preferred core inner diameters are 76 mm and 152 mm.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards : Monthly Additions'.

This Indian Standard has been developed from Doc : No. ET 02 (3869).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at New India Printing Press, Khurja, India